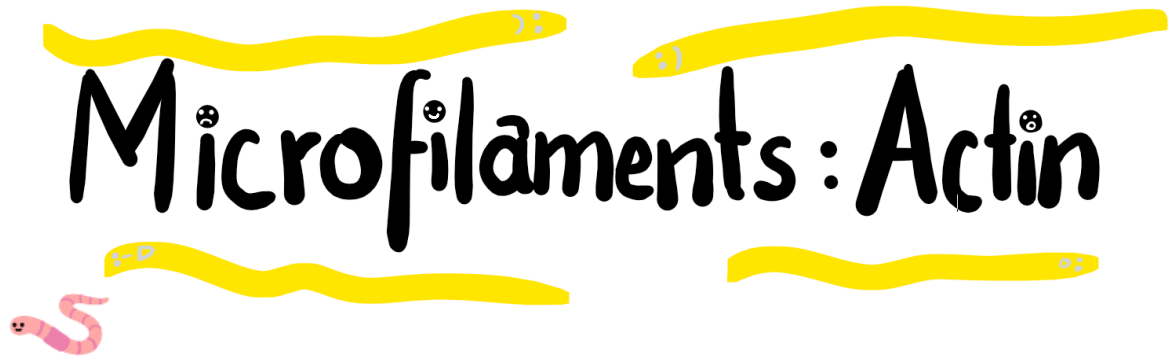

Microfilament | Actin

# Progress (%)	100
Status	In progress
Content Type	Notes
Chapter	CYTOSKELETAL PROTEINS AND TECHNIQUES IN CELL BIOLOGY The Cytoskeleton and Cell Motility
Course	Graduation
Reference	From NCERT Kerp's Cell and Molecular Biology www.ncbi.nlm.nih.gov www.sciencedirect.com
Subject	Biochemistry
Topic	Actin Microfilament

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Microfilaments

Definition of microfilament

Microfilaments are thin, flexible protein fibers that make up part of the cytoskeleton in eukaryotic cells. It is composed mainly of the protein actin and is involved in a variety of cellular processes, such as cell motility, intracellular transport, and muscle contraction.

Microfilaments are the thinnest of the three types of filaments

Struture of microfilaments

Microfilaments, also known as actin filaments, are one of the three main types of cytoskeletal filaments in cells. They are composed of the protein actin and have a diameter of about 7 nm. Microfilaments are organized into two main types of structures:

1. F-actin: This is the unpolymerized form of actin, which consists of individual actin monomers.
2. Filamentous actin (F-actin): This is the polymerized form of actin, which consists of many actin monomers linked together to form long, helical filaments.

Organisation of microfilaments

Microfilaments are organized into various structures, including:

- Stress fibers: These are bundles of microfilaments that provide mechanical support to the cell.

- Filopodia: These are thin, finger-like projections of the cell that are composed of microfilaments.
- Microvilli: These are small, finger-like projections of the cell that are composed of microfilaments and that increase the surface area of the cell.
- The contractile ring: The ring-like structure that forms around the equator of the cell during cell division which composed of microfilaments.

Microfilaments are dynamic structures that are constantly being assembled and disassembled in response to signals from the cell. They play important roles in cell movement, cell division, and the maintenance of cell shape.

Actin

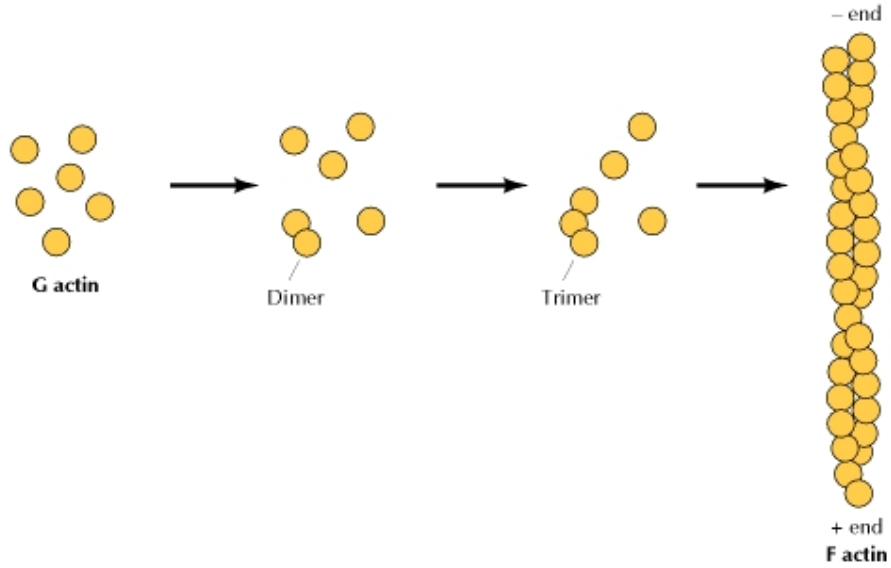
Definition of Actin

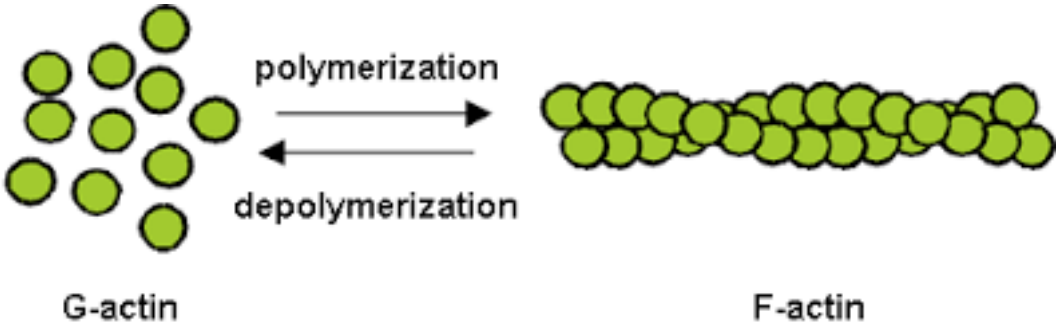
Actin is a type of protein that makes up microfilaments. Microfilaments are thin, flexible protein fibers that are part of the cytoskeleton in eukaryotic cells and composed of actin protein subunits. In other words, microfilaments are the assembled form of actin protein.

The main difference between actin and microfilaments is that actin is a protein and microfilaments are structures made up of actin proteins.

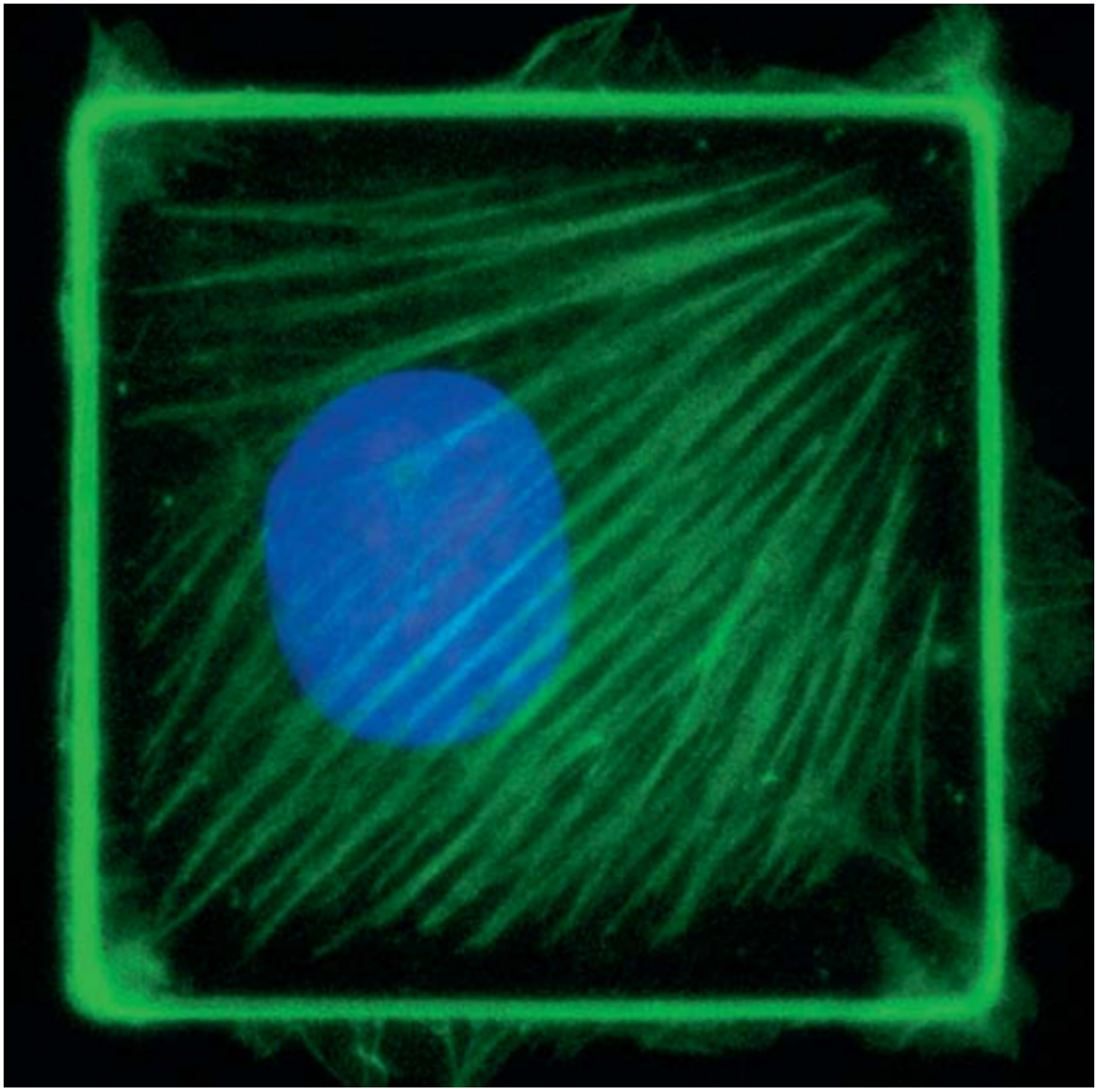
Actin structure

- Actin is a globular protein composed of a single polypeptide chain.
- It has a compact, spherical shape and is approximately 42kDa in size.
- The actin protein molecule is made up of two main domains: a globular head and a filamentous tail.
- The globular head contains binding sites for other proteins, while the filamentous tail polymerizes to form the actin filaments that make up the cytoskeleton.
- Actin filaments can associate with other actin filaments, as well as with other cytoskeletal proteins, to form a highly dynamic and regulated network that plays a critical role in many cellular processes.



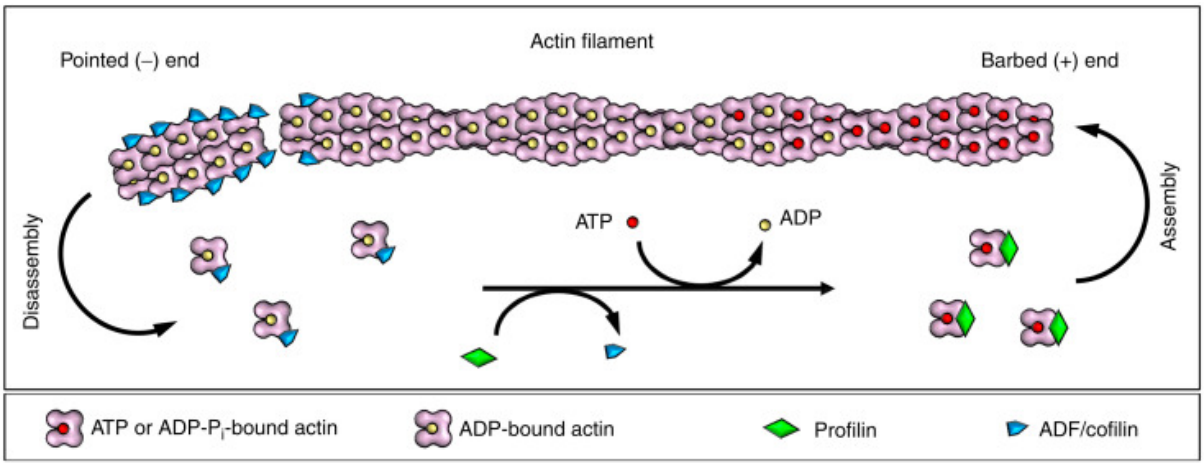


- Green fluorescent antibody that binds to the cytoplasmic protein actin, a component of the cytoskeleton.



Fluorescence micrograph of an endothelial cell—a type of cell that lines the inner surface of blood vessels. The cell is square because it has spread itself over a tiny square-shaped patch of an adhesive protein called fibronectin that was applied to a culture dish. The cell appears to be mounted in a green frame because it was treated with a green fluorescent antibody that binds to the cytoplasmic protein actin, a component of the cytoskeleton.

Actin Filament assembly and disassembly



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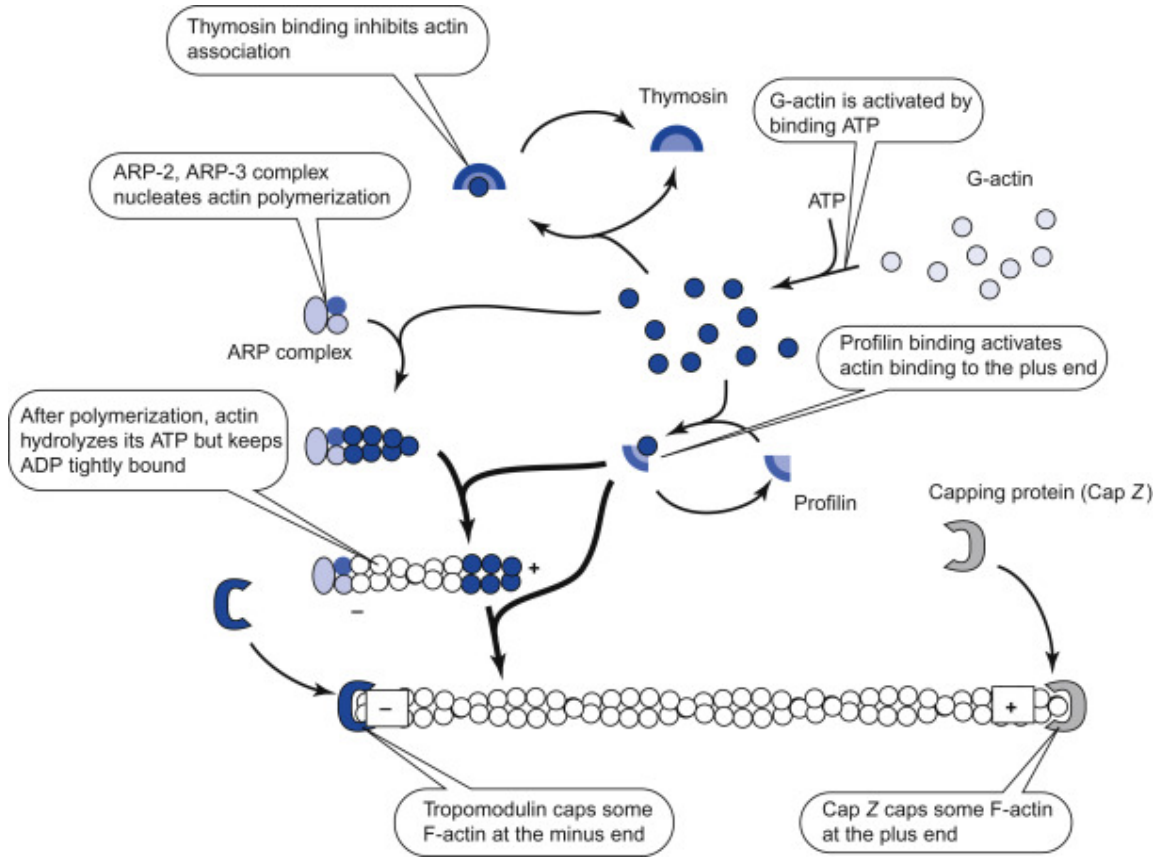
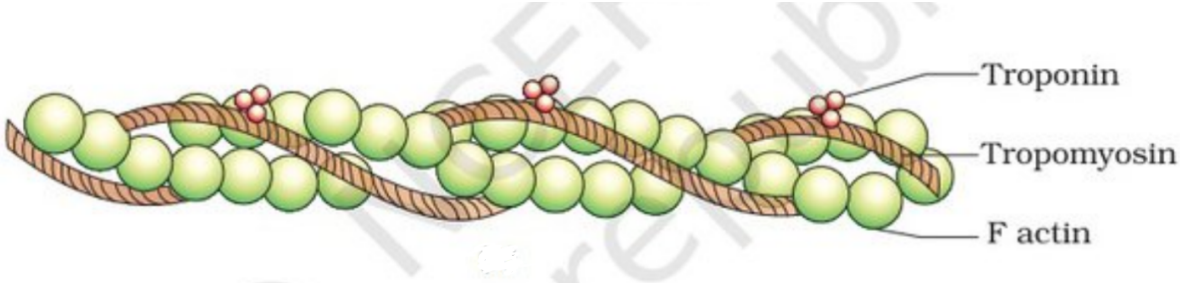


Assembly and stabilization of microfilaments (actin filaments). Actin binds ATP and begins assembly by binding to actin-related proteins (ARPs) that serve as a nucleation site, usually just under the cell membrane in the cortex of the cell. The ARP complex can also bind F-actin on the side of the filament, so it can build a tree-like web from individual actin filaments. After assembly, actin hydrolyzes its bound ATP, but the ADP remains tightly bound. Formation and stabilization of F-actin is regulated by proteins that bind the free monomer. Thymosin binds to the free monomer and inhibits its association with either the minus or plus end of the F-actin. Profilin binds to the free monomer and inhibits its association with the minus end but markedly enhances its association with the plus end. Cap *Z* binds to the plus end of the F-actin and stabilizes it. The minus end can be stabilized by remaining bound to the ARP complex.

In muscle cells, tropomodulin binds to the minus end and stabilizes it.



Actin functions

Actin plays several important roles in eukaryotic cells, including:

1. Cell structure: Actin is a major component of the cytoskeleton, which provides the cell with its shape and helps to maintain cell integrity.
    - Also provide structural support for various types of cellular projections
2. Cell movement: Actin filaments are involved in the process of cell migration and also play a role in muscle contraction.
    - Actin is involved in intracellular motile processes, such as the movement of vesicles, phagocytosis, and cytokinesis.
    - In fact, plant cells rely primarily on actin, rather than microtubules, to serve as tracks for the long-distance transport of cytoplasmic vesicles and organelles. This bias toward actin-based motility reflects the rather restricted distribution of microtubules in many plant cells .
3. Cell division: Actin helps to regulate the division of cells and is involved in the formation of the contractile ring that separates the dividing cells.
4. Vesicle and organelle transport: Actin can also be involved in the transport of vesicles and organelles within cells.
5. Signal transduction: Actin can participate in the regulation of signaling pathways that control cell behavior.

Overall, actin is a key protein that is essential for many of the basic functions of eukaryotic cells.